Best Available Science

Erosion Hazard Areas & Erosion Hazards Near Sensitive Water Bodies

Prepared for the City of Sammamish
by AMEC Environment and Infrastructure Inc.

Introduction

The City of Sammamish (Sammamish) is in the process of reviewing its Environmental Critical Areas regulations (ECA). Designation and protection of environmentally critical areas must include Best Available Science (BAS) according to the Growth Management Act (GMA, RCW 36.70A). This memo provides a summary of the BAS relevant to erosion hazard areas (SMC 21A.50.220) and the erosion hazards near sensitive water bodies overlay (SMC 21A.50.225), and focuses on scientific review articles and government agency guidance documents that have been published since Sammamish last updated its ECA codes in 2005. The intent is to characterize accurately the general conclusions of existing studies and to provide a context for updating the existing ECA.

Soil erosion is the removal of soil from its original location by wind, water, ice, or gravity (Ecology, 2011). Four principal factors of soil erosion are soil characteristics, climate, topography, and ground cover (Goldman et. al., 1986). Erosion is typically associated with sedimentation, which is the settling of soil particles in water by gravity (Ecology, 2011). Because of impacts associated with erosion and sedimentation, erosion and sedimentation control (ESC) plans are typical requirements for ground disturbing construction throughout Western Washington. Additionally, many jurisdictions limit activities that can contribute to erosion and sedimentation.

Puget Sound-Wide Issues

Impacts of Erosion and Sedimentation

The impacts of erosion and sedimentation are understood to include (Ecology, 2011):

- Nutrient loading from phosphorus and nitrogen, which are attached to soil particles and transported to lakes and streams, causing a change in the water pH, algal blooms, and oxygen depletion, which leads to eutrophication and fish kills.
- Eroded soil particles decrease the viability of macro-invertebrates and food-chain organisms, impair the feeding ability of aquatic animals; they also clog gill passages of fish and reduce photosynthesis.
- Sediment-clogged gravel diminishes fish spawning and can smother eggs or young fry.

- Natural, nutrient-rich topsoils erode, making re-establishment of vegetation difficult without applying soil amendments and fertilizers.
- Silt fills culverts and storm drains, decreasing capacities and increasing flooding and maintenance frequency.
- Detention facilities fill rapidly with sediment, decreasing storage capacity and increasing flooding.
- Sediment clogs infiltration devices, causing failure.
- Shallow areas in lakes form rapidly, resulting in growth of aquatic plants and reduced usability.
- Water treatment for domestic uses becomes more difficult and costly.
- Turbid water replaces aesthetically pleasing, clear, clean water in streams and lakes.

Erosion and Sedimentation Control Practices

Based on review of neighboring jurisdictions' critical area ordinances and AMEC's experience with other jurisdictions across Puget Sound, we find the main regulatory protections for erosion hazard areas typically involve the requirement to prepare and implement a Temporary Erosion and Sedimentation Control Plan (TESCP), restrictions on developable land, seasonal restrictions of clearing and grading, control of stormwater discharges, and vegetation management.

To address erosion and sedimentation impacts, grading and stormwater codes of agencies and municipalities require preparation of a TESCP before grading permits are issued. Such plans are prepared based upon the requirements of the adopted Surface Water Design Manual. If the area of ground disturbance exceeds 1 acre, then a National Pollutant Discharge Elimination System (NPDES) permit is also required. Projects seeking NPDES permit coverage typically conform to the conditions of the Department of Ecology's (Ecology) Construction Stormwater General Permit (CSWGP), which include implementation of a TESCP and protocols for monitoring site discharges for compliance with water quality standards.

Minimum requirements and Best Management Practices (BMPs) for TESCPs are established by Ecology in the Stormwater Management Manual for Western Washington, and by King County in the Surface Water Design Manual; municipalities typically adopt these minimum requirements and BMP design standards, or their equivalents, as part of their stormwater management requirements for site development. The City of Sammamish applies the King County requirements. Whereas King County identifies nine categories of ESC measures that must be considered, the City of Seattle has a list of 18 required elements for managing construction stormwater to minimize erosion and sediment impacts:

- Element #1 – Mark Clearing Limits And Sensitive Areas
- Element #2 – Retain Top Layer
- Element #3 – Establish Construction Access
- Element #4 – Protect Downstream Properties and Receiving Waters
- Element #5 – Prevent Erosion and Sediment Transport from the Site

- Element #6 – Prevent Erosion and Sediment Transport from the Site by Vehicles
- Element #7 – Stabilize Soils
- Element #8 – Protect Slopes
- Element #9 – Protect Storm Drains
- Element #10 – Stabilize Channels and Outlets
- Element #11 – Control Pollutants
- Element #12 – Control Dewatering
- Element #13 – Maintain BMPs
- Element #14 – Inspect BMPs
- Element #15 – Execute Construction Stormwater Control Plan
- Element #16 – Minimize Open Trenches
- Element #17 – Phase the Project
- Element #18 – Install Permanent Flow Control and Water Quality Facilities

Some jurisdictions may have additional TESCP standards. Redmond's requirements include dust control and "contingency plans for controlling spills and other potential pollutants" that are ready to implement at the construction site.

Ecology has a procedure to evaluate emerging technologies for stormwater treatment known as the Technology Assessment Protocol – Ecology (TAPE protocol). The department maintains on their website[1] a list of emerging technology BMPs that have demonstrated the capability to achieve specific pollutant reduction targets. Practices that have followed Ecology's procedures to demonstrate performance capability are designated for Pilot Use, Conditional Use, or General Use, depending on the amount of verification that has been performed. One of the categories of runoff treatment evaluated as part of the TAPE protocol is construction runoff. There are presently six technologies for removing sediment designated for General Use. These technologies have been refined and added to Ecology's list of approved BMPs more recently than the 2005 update to the ECA, and can be categorized as either chitosan-enhanced sand filtration or electro-coagulation treatment technologies. These BMPs, together with the erosion and sedimentation control BMPs of the most recently published Stormwater Management Manual for Western Washington (Ecology, 2011), constitute the best available science for treatment of sediment-laden runoff. While we recommend that practices designated for General Use through the TAPE protocol be accepted by the City as part of their drainage and stormwater standards to afford greater flexibility to owners and developers, because these practices could apply throughout the City and not just at erosion hazard areas, we do not recommend revising the erosion hazard ECA to identify specific ESC practices. We recommend that specific ESC practices and standards adopted by the City as part of drainage and stormwater requirements continue to be referenced in SMC 21A.50.220(2). (See AMEC Lake Management Areas BAS memo dated 4/10/12.)

Wet Season Restrictions

It is not unusual to have seasonal requirements for clearing and grading stated in critical areas codes, or in stormwater codes that are referenced by critical area codes. Ecology (2011) states that for Western Washington, soils must not remain exposed and unworked for more than 7

[1] http://www.ecy.wa.gov/programs/wq/stormwater/newtech/index.html

days during the dry season (May 1 – September 30), and for no more than 2 days during the wet season (October 1 – April 30).

For work within critical areas, some municipalities adopt more stringent seasonal restrictions than Ecology. The approach taken by Sammamish is discussed in the following section.

Based on our review of other jurisdictions, the City of Redmond uses an approach where wet season work requirements are tailored to specific critical areas and subject to special conditions. Redmond establishes "area classes" for sites within critical areas that determines what work is allowed during the wet season (Redmond, 2012). Relative to erosion hazard areas (other critical areas are not considered in the list below), wet season work is prohibited in Redmond where:

- Slopes are 40 percent or greater (Area Class 1)
- Site is within 25 feet of Lake Sammamish Ordinary High Water or within 15 feet of steep slopes (greater than 40 percent) (Area Class 2a)

When Redmond allows wet weather work to occur, two special requirements apply:

- Projects must have a City-approved Seasonal Suspension Plan for suspending work until the end of the rainy season if TESC measures are found to be inadequate
- Additional performance security must be provided for monitoring, operation of TESC measures, implementation of the Seasonal Suspension Plan, and site restoration

See the "Relevance to Existing City Regulations" section for discussion of how the requirements of Sammamish' ECA compare to Redmond's requirements.

Unique Conditions in Sammamish

The City of Sammamish has a number of resources that are susceptible to impacts from erosion and sedimentation. The western side of the City is bounded by Lake Sammamish, an important resource for recreation and wildlife habitat. It is vulnerable to increases in phosphorus, which causes algae to grow. With excessive algal growth, the lake surface can become "scummy," oxygen becomes depleted as algae decays, and the lake loses recreational appeal and value as wildlife habitat. This process is called eutrophication.

There are steep bluffs along the western edge of the Sammamish plateau. Excessive water flowing down these bluffs can form gullies and ravines where soils are highly erosive, which results in downstream sedimentation, and can initiate processes of soil wasting.

The East Lake Sammamish Basin and Nonpoint Action Plan (King County, 1994) describes the significance of the erosion hazard as follows:

> All of the basin's streams flow westward, down a steep slope into Lake Sammamish. Significant channel downcutting and landsliding have occurred along these west slopes,

with adverse effects on streamside properties, fish habitats, and base-of-slope roads where eroded sediment clogs culverts and causes flooding. The erosion and landslide problems are the most severe in the Panhandle and Monohon drainages, which share the steepest slopes in the basin and erosive soils, and have extensive urban development in their headwaters. Historic development along the shore of Lake Sammamish also has substantially altered shoreline and lower-reach fish habitat and blocked anadromous fish access to most streams.

Problems in the Panhandle drainages result from fundamental alterations in the natural hydrologic regime as a result of upland development. In the pre-developed state, these channels were fed almost entirely by subsurface flow. A surface drainage course was established only part way up the western slope of the subbasin, where springs and seeps emerged with sufficient discharge to carve a channel… Following development, however, upland runoff no longer infiltrates into the subsurface. It is collected by the storm-drain system, and runs off cleared and compacted ground, even if that ground is later landscaped. This flow then erodes from the very top of the western slope, forming a new channel and transporting substantial amounts of sediment that is derived from the new channel formation… Topographic and geologic conditions throughout the Monohon subbasin are similar to those in the Panhandle farther north.

Relevance to Existing City Regulations

In the City of Sammamish Environmentally Critical Areas code (ECA), both “Erosion hazard areas” and “Erosion Hazard near Sensitive Water Bodies” are identified.

Erosion Hazard Area

“Erosion hazard areas” (Figure 1) are those areas in the City that are likely to become unstable when disturbed, due to the combination of soil characteristics and slopes that make the area more susceptible to erosion by water flow than other areas in the City. Disturbing these soils through vegetation clearing, grading, and other activities can lead to the mobilization of soil and sediments by precipitation or due to exposure to surface runoff; when sediments enter streams, wetlands, and lakes, fish and wildlife habitat can be impacted.

To limit the potential impacts from the development of erosion-susceptible soils in the Erosion Hazard Areas, the ECA establishes conditions, restrictions and standards for clearing and land development, including:

- Preparation of a temporary erosion control plan
- Seasonal restrictions on land clearing, grading, and filling
- Existing vegetation retention
- Ability for the City to require that surface water discharges from a site are monitored for compliance with water quality standards.

Erosion Hazard Area Seasonal Clearing Restrictions

Per SMC 21A.50.220(1), land clearing, grading, filling, and foundation work in an erosion hazard area is allowed only from May 1 to September 30, and is not allowed from October 1 through April 30. The dates of this restriction are consistent with Ecology (2011) and other cities, such as Redmond (2007). The Sammamish ECA is more restrictive than Ecology and King County, which limit the duration of exposed soils during the wet season to two days, whereas Sammamish prohibits clearing and grading altogether, with several exceptions. Sammamish ECA is generally consistent with the City of Redmond, which also prohibits wet-season work on steep slopes and proximate to Lake Sammamish.

Exceptions to the seasonal clearing restriction may be authorized if the director determines a hazard area will not be adversely impacted by the proposed construction work or the hazards are fully mitigated. The specific criteria that would constitute "fully mitigated" conditions are not defined in the ECA. The director also may require a critical areas study of site design elements pertinent to erosion and sediment control, and/or an indemnification/release agreement.

Timber harvests may be allowed pursuant to an approved forest practice permit issued by Washington State Department of Natural Resources. Specific criteria relating to whether timber harvest would be approved by the City are not defined further.

While the erosion hazard area clearing restrictions are more stringent than some jurisdictions', clearing erodible soils during the wet season poses substantial risks for downstream sediment impacts to Lake Sammamish so that such stringency is justified by the best available science (Redmond, 2012; King County, 1994). The director can make exceptions where the risk is "fully mitigated." Based on our experience, it would be useful for applicants and staff to have a common understanding of what would satisfy this condition; AMEC recommends that minimum requirements to achieve the "fully mitigated" status are defined either in the ECA or in the City's Surface Water Design Manual Addendum to include the following (recommendations are based on Ecology [2010], King County [2009], and Redmond [2012]):

- Pre-design site inspection by a licensed engineer or geologist to identify erosion hazard areas, no-disturbance areas, and resources downstream of the site that are to be protected.
- Development and implementation of a TESCP, which must include:
    - The minimum requirements from the Surface Water Design Manual most recently adopted by the City
    - Provisions to store site construction runoff and treat runoff sufficiently to meet water quality standards prior to discharge
    - Daily and post-storm inspections of TESC best management practices
    - Establishment of a TESC lead, who is a Certified Erosion and Sediment Control Lead in the State of Washington, and will be available on-call and respond to TESC non-compliance
    - A water-quality monitoring plan for site discharges, where the applicant is responsible for measuring turbidity of stormwater released from the site and

maintaining records of monitoring data that shall be available upon request by the City or Ecology. Monitoring protocols should conform to the monitoring requirements of the CSWGP.

  - A Contingency Plan incorporated into the TESCP that identifies corrective actions and BMPs that will be implemented if monitoring shows discharge water quality exceeds water quality standards, and that specifies materials to be stockpiled on site for use in an ESC response
  - A Seasonal Suspension Plan for suspending work until the end of the rainy season if TESC measures are found to be inadequate
- Construction stormwater systems and TESC best management practices are to be sized for a minimum of a 10-year storm interval.
- Implementation of a stormwater runoff infiltration system or, when infiltration is not feasible due to the site soils and/or geologic conditions, conveying stormwater via a continuous storm pipe downslope to a point where there is no erosion hazard area downstream from the discharge. (This requirement could preclude some sites where infiltration is not feasible and obtaining downstream easements for a stormwater pipe is not possible.)
- The owner must provide a financial guarantee in accordance with SMC 27A.15 specifically to cover all costs of implementing the approved TESCP, monitoring site discharges, permanently stabilizing the site, and restoring any off-site impacts, including materials, labor, and City costs, to be used if the development is stalled or not completed.
- Preparation and implementation of site grading, stabilization, and restoration plans by a licensed engineer, with certification by a geotechnical engineer that these plans are sufficient to prevent erosion and sedimentation of susceptible soils.
- Preparation of a Vegetation Management Plan by a licensed landscape architect for establishment of permanent vegetation on the site following completion of clearing and grading work.

Erosion Hazard Area Additional Requirements

Per SMC 21A.50.220(3), all subdivisions, short subdivisions, or binding site plans on sites with erosion hazard areas must retain existing vegetation on all lots until building permits are approved for development on individual lots. Per SMC 21A.50.220(4), where erosion from a development site poses a significant risk to downstream waters, the City may require monitoring of surface water discharges from the site. This section does not indicate what corrective or remedial actions are to occur when monitored surface water discharges indicate non-compliance with water quality criteria, or how these would be triggered. This information could be incorporated directly into the ECA, or the ECA could reference construction stormwater guidance incorporated into other developmental regulations such as the Surface Water Design Manual Addendum (similar to how Redmond uses the Stormwater Technical Notebook to establish specific requirements for working within critical areas). Because of the importance of correcting ineffective ESC measures before downstream resources are impacted, AMEC

recommends adding a requirement to the ECA for a Contingency Plan to be prepared in advance and implemented when a measured discharge from an area of clearing or grading within and Erosion Hazard Area exceeds state water quality criteria.

Per SMC 21A.50.220(5), the use of hazardous substances, pesticides, and fertilizers in erosion hazard areas may be prohibited by the City. The intent of this section is that these substances may be mobilized with eroded soils. AMEC did not find Best Available Science to validate or dispute that these materials would cause a downstream impact due to their mobilization with eroded soils. No change is recommended at this time.

Erosion Hazards Near Sensitive Water Bodies

"Erosion Hazard near Sensitive Water Bodies" (EHNSWB) are those erosion hazard areas proximate to receiving waters that would be impacted by the release of sediments or are susceptible to accumulation of sediments. The EHNSWB Overlay of the ECA (Figure 2) is intended to protect lakes and streams from sediment loads by establishing a no-disturbance zone on erodible slopes adjacent to sensitive water bodies. The overlay includes but is not limited to erosion areas along the sloped bank on the west side of the plateau, and restricts development in this area to individual family homes, access drives, utility easements, and parks.

The no-disturbance area within the EHNSWB overlay prohibits development, including subdivisions and short plats, but provides some exceptions for construction of single-family homes on pre-existing lots. In addition to the no-disturbance area contained within the EHNSWB overlay, the ECA identifies a number of specific drainage design requirements intended to require certain types of new development that drain to the no-disturbance area (subdivisions, short subdivisions, public institutions, commercial site developments, and binding site plans) to evaluate infiltration as the primary means of managing stormwater runoff. When it is not practicable to infiltrate the entirety of the 100-year storm flow, subdivisions and binding site plans must set aside 25 percent of the site as open-space and the imperviousness of the site is limited to 35 percent of the gross site area. The ECA also requires drainage outlets to be designed using the Best Available Science.

Erosion Hazard Maps

The Erosion Hazard areas and EHNSWB overlay mapped for the City of Sammamish ECA are based on locations where slopes are underlain by soil types that are known to be highly erodible, and where downstream water resources are susceptible to the impacts of increased sediment loading. EHNSWB areas are delineated where erodible slopes are proximate to stream channels, wetlands, and lakes. The EHNSWB overlay provides protection to Lake Sammamish, which is highly sensitive to phosphorus that is transported with sediment, and several streams known to provide aquatic habitat. Because these conditions have not changed since the most recent ECA update, no changes to the mapped erosion hazards are recommended.

Erosion Hazards Near Sensitive Water Bodies Development Standards

Per SMC 21A.50.225(3)(a), a no-disturbance area is established on the sloped portion of the EHNSWB overlay. The upland boundary lies "at the first obvious break in slope from the upland plateau onto the steep valley walls." AMEC found this definition to be consistent with other

municipalities' descriptions of erosion hazard areas. Because the definition of Erosion Hazard Area in SMC 21A.15.415 references slopes over 15 percent, and to improve clarity, AMEC recommends changing the language to "at the first time slopes exceed 15 percent from the upland plateau onto the bluff or other downgradient area."

The community development department is to maintain maps of the approximate location of no-disturbance areas, which "shall be subject to field verification for new development proposals." However, in City staff's experience they largely under-represent the no-disturbance area, and the City should consider using LIDAR topographic data to improve the accuracy of the maps. The ECA is not clear whether the City alone could conduct the field verification or if other parties such as qualified geologists or engineers could perform the field verification of the extent of the non-disturbance area on behalf of a landowner or developer, for subsequent review by the City. The current practice is that applicant and staff identifies the field location of the no-disturbance area. AMEC recommends including language stating that qualified consultants, civil engineers, or geologists licensed in the State of Washington, will field locate the extents of the no-disturbance areas and that the results will be subject to City review and approval.

SMC 21A.50.225(3)(b) restricts development in the no-disturbance area of the EHNSWB overlay to individual family homes, access drives, utility easements, and public park facilities. The intent of the overlay is to prevent sediment transport from sites with highly erodible soils to sensitive receiving waters, so development with potentially substantial earth disturbing activity is restricted. It may be technically possible to develop a site without impacting downstream resources through the implementation of robust TESCP with site monitoring, contingency plans, and the other measures identified above in the discussion of "fully mitigated" conditions as applied to Erosion Hazard Area Seasonal Clearing Restrictions. However, because of the intense effort and costs of implementing thorough, reliable controls with monitoring and contingency measures, and the possibility of equipment malfunctions and human errors, risks and performance uncertainties would remain. Generally, best available science for protecting sensitive resources requires buffers and offsets, and does not support increasing risk-associated activities proximate to the resources. For these reasons we do not recommend changing the restrictions of SMC 21A.50.225(3)(b). The provision of SMC 21A.50.225(3)(b)(i)(d) that allows for public park facilities to be developed within the no-disturbance overlay poses a level of risk that remains in the ECA, but is borne by the City rather than owners or developers; for public parks the City would be responsible for effectively managing the erosion risks.

SMC 21A.50.225(3)(c-f) establishes requirements for new development (subdivisions, short subdivisions, public institutions, commercial site developments, and binding site plans) that drained to the no-disturbance area. These requirements act to establish stormwater infiltration as the primary means of managing stormwater runoff. When it is not practicable to infiltrate the entirety of the 100-year storm flow, subdivisions and binding site plans must set aside 25 percent of the site as open-space and the imperviousness of the site is limited to 35 percent of the gross site area. Recognizing that historic drainage patterns may have changed in locations with engineered storm drainage systems, AMEC recommends that the language be revised from "…sites that drained predeveloped runoff to the no-disturbance zone…" to "sites that drain runoff to the no-disturbance zone."

SMC 21A.50.225 (3)(d) currently specifies for all new single-family development resulting in total site impervious surface greater than 2,000 square feet that a drainage design be provided using the four specific approaches, listed in order of preference:

- Infiltration of all site runoff to the maximum extent technically feasible
- Infiltration of impervious surface runoff to the maximum extent technically feasible
- Design a drainage system that provides a drainage outlet designed using the BAS techniques to limit the risk of landslide or erosion to the no-disturbance area
- Modification of, addition to, or replacement of single detached residences and improvements in existence before January 1, 2006, that do not add more than 200 square feet of impervious surface, are exempted.

Based on our AMEC's experience, thresholds used to trigger drainage control measures are typically tied to the total project area or total project impervious surfaces, where the "project" is defined to encompass areas of new development and redevelopment. With the current ECA language, small changes to a site that has nearly 2,000 square feet of existing impervious surface could trigger an engineered drainage design, even if the site had been previously stabilized. The EHNSWB overlay is intended to reduce downstream erosion and sediment impacts, and preventing sediment transport during development is more likely if projects are required to analyze and control the site drainage than if they are not required to mitigate impacts through stormwater management and erosion control practices. Best available science does not support exempting projects based on their size. The use of "total site impervious" will effectively trigger drainage controls and ESC on more projects than if this section were changed to apply to "projects" or "new and replaced impervious surfaces" – for this reason no changes are recommended.

The ECA takes the approach that stormwater infiltration is the preferred method of avoiding development impacts to the sensitive water bodies associated with the EHNSWB overlay. Other jurisdictions do not share this approach, and allow for alternative means of protecting erosive soils and downstream resources. The City of Redmond allows the following alternate methods of protecting erodible slopes:

- Convey stormwater via a continuous storm pipe downslope to a point where there are no erosion hazard areas downstream from the discharge
- Discharge at flow durations matching pre-developed conditions, with adequate energy dissipation, into existing channels that previously conveyed storm water runoff in the predevelopment state
- Or, disperse stormwater discharge upslope of the steep slope onto a low-gradient undisturbed buffer demonstrated to be adequate to infiltrate all surface and stormwater runoff, and where it can be demonstrated that such discharge will not increase the saturation of the slope.

The approach taken by Redmond and other jurisdictions is consistent with AMEC's experience. Where stormwater can be conveyed in a sealed drainage system to an established, stable

drainage system, or to a point downstream of the erosion hazard area, the intent of the ECA would be achieved in a manner that allows additional flexibility to land owners – so long as this is the historic discharge location for the stormwater from the site (this would not apply to a new discharge to a stream where site runoff did not previously flow, which may be impacted by the additional flow).

SMC 21A.50.225(3)(c)(iii) and SMC 21A.50.225(3)(d)(iii) indicate that for projects that cannot infiltrate all of the site runoff, the system must provide a drainage outlet designed using the best available science techniques to limit the risk of landslides and erosion. In AMEC's experience, when infiltration is not feasible due to the site soils and/or geologic conditions, conveying stormwater via a continuous storm pipe downslope to a point where there is no erosion hazard area downstream from the discharge, and discharging at flow durations matching pre-developed forested land cover and providing stream erosion protection (King County Level 2 flow control), would constitute an outlet designed using the best available science.

Requirements for evaluating stormwater infiltration as the preferred stormwater management approach should be consistent with the City's stormwater and drainage requirements. Any infiltration of stormwater near a steep slope needs to be properly analyzed to avoid introducing too much water that could destabilize the slope, as discussed in the Best Available Science report for landslide hazard areas.

The ECA includes flexibility in Section 21A.50.225(3)(h) to authorize methods of land development that could achieve protection of sensitive waterbodies and water quality while accommodating new development. In AMEC's experience, this flexibility is appropriate.

Table 1. Summary of Recommended ECA Code Amendments

Recommended Amendment	Professional Experience
Revise the ECA or establish director's rules to define the "fully mitigated" conditions when construction is excepted from the seasonal clearing restrictions and allowed during the wet season [SMC 21A.50.220(1)(a)]	Clarification reduces uncertainty for applicants
Address actions required when measured site discharges exceed state water quality criteria [SMC 21A.50.220(4)]	Require a Contingency Plan (Redmond, 2012)
Identify parties responsible for field location of no-disturbance zone [SMC 21A.50.225(3)(a)]	Clarification reduces uncertainty for applicants
Change part of description of no-disturbance area from "at the first obvious break in slope from the upland plateau onto the steep valley walls." to read "at the first time slopes exceed 15 percent from the upland plateau onto the bluff or other downgradient area" and require delineation by qualified consultant [SMC 21A.50.225(3)(a)]	Using a more precise criteria to define the area reduces uncertainty for applicants
Update maps to correctly label "Erosion Hazard Areas" (Figure 1) and "Erosion Hazard Near Sensitive Water Body Overlay" (Figure 2)	Map labeling should match ECA definitions
Change language specifying which developments must evaluate infiltration from those that "drained to" the no-disturbance zone to those that "drain to" the no-disturbance zone. [SMC 21A.50.225(3)(b)]	Evaluating a past historic condition is speculative whereas the current condition is of more consequence to potential impacts
Clarify that conveying water via a continuous storm pipe downslope to a point where there is no erosion hazard area downstream from the discharge, and discharging at flow durations consistent with King County Level 2 flow control, constitutes an outlet designed using the best available science. [21A.50.225(3)(c)(iii), 21A.50.225(3)(d)(iii)]	Clarification reduces uncertainty for applicants by establishing an acceptable standard

Research or Monitoring Needs

Based on City staff input, existing City maps of the non-disturbance areas are based on topographic information that may not be sufficiently precise to map these areas accurately. Consider whether LIDAR topographic data would improve the accuracy of City maintained maps of the no-disturbance areas.

References

Bellevue Part 20.25H Critical Areas Overlay District

City of Redmond Clearing, Grading, and Stormwater Management Technical Notebook Issue Number 6, Public Works Department, February 23, 2012.

City of Redmond Zoning Code 21.64

City of Sammamish Municipal Code, Title 21A, Development Code

City of Sammamish Surface Water Design Manual Addendum

Ekholm, Petri, and Lehtoranta, Jouni. (2012) “Does control of soil erosion inhibit aquatic eutrophication?” Journal of Environmental Management Vol. 93:1, January 2012.

Issaquah Municipal Code Chapter 18.10

King County Surface Water Design Manual (2009)

King County (1994). Final East Lake Sammamish Basin and Nonpoint Action Plan. King County Surface Water Management Division. December 1994.

Washington State Department of Ecology (2010). Construction Stormwater General Permit. Issued December 1, 2010. Expiration date December 31, 2015.

Washington State Department of Ecology (2011). (Draft) Stormwater Management in Western Washington. Volume 2 Construction Stormwater Pollution Prevention. Water Quality Program. November Draft 2011.

City of Sammamish
WASHINGTON

2005 CAO UPDATE
DRAFT

Geologically Hazardous Areas & Frequently Flooded Areas

Available GIS information shown may not include all critical areas and locations have not been verified.

- City Limits
- King Co UGA
- Landslide Hazards
- Seismic Hazards
- Erosion Hazards
- Contours 20ft
- Coal Mines
- Floodplains
- Water Bodies
- Streams

0 2,500 5,000 Feet

This map is a geographic representation based on information available. It does not represent survey data. No warranty is made concerning the accuracy, currency, or completeness of data depicted on this map. Data obtained from King County GIS 2002.

MAP DATE: MAY 2005

Berryman & Henigar
720 Third Avenue, Suite 1200
Seattle, Washington 98104-1620
Tel: (206) 505-3400
Fax: (206) 505-3406
www.us.bureauveritas.com

Figure 1. Geologically Hazardous Areas & Frequently Flooded Areas Map (Note: the City Limits line may not be up to date)

City of Sammamish
WASHINGTON

2005 CAO UPDATE
DRAFT

Wetlands and Special Overlays

Available GIS information shown may not include all critical areas and locations have not been verified.

Wetlands locations based on King County GIS Jan 2005

Legend

- City Limits
- King Co UGA
- Wetlands (King Co)

Special Overlays

- Wetlands Overlay
- Erosion Overlay

0 2,500 5,000 Feet

Special Overlays: City of Sammamish

This map is a geographic representation based on information available. It does not represent survey data. No warranty is made concerning the accuracy, currency, or completeness of data depicted on this map. Data obtained from King County GIS 2005.

MAP DATE: August 2005

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P:\Mapping\Maps_Generated\Sammamish\projects\critical_areas\maps\Wetlands & Special Overlays 11x17 Aug2005.mxd

Figure 2. Wetlands and Special Overlays Map (Note: the City Limits line may not be up to date)